

MATERIAL SAFETY DATA SHEET

SRM Supplier: National Institute of Standards and Technology
Standard Reference Materials Program
Bldg. 202 Rm. 211
Gaithersburg, Maryland 20899

SRM Number: 3122
MSDS Number: 3122
SRM Name: Hafnium Standard Solution
Date of Issue: 13 September 2000

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SECTION I. MATERIAL IDENTIFICATION

Material Name: Hafnium Standard Solution

Description: SRM 3122 is a 50 mL single element solution prepared gravimetrically to contain a nominal 10 mg/g of hafnium with approximate nitric acid and hydrofluoric acid combined volume fractions of 10 % and 2 %, respectively.

Other Designations: **Hafnium*** in **Nitric Acid** (aqua fortis; hydrogen nitrate; azotic acid; engraver's acid)/**Hydrofluoric Acid** (hydrogen fluoride; fluorhydric acid) in **Standard Solution**

Name	Chemical Formula	CAS Registry Number
Nitric Acid	HNO ₃	7697-37-2
Hydrofluoric Acid	HF	7664-39-3
Hafnium	Hf	7440-58-6

DOT Classification: Corrosive Liquid, Toxic
N.O.S. (Nitric Acid and Hydrofluoric Acid) UN2922

Manufacturer/Supplier: Available from a number of suppliers.

* The addition of hafnium to hydrofluoric acid and nitric acid, along with other intermediate chemical reactions, forms hafnium compounds which will precipitate upon evaporation or drying of the solution.

SECTION II. HAZARDOUS INGREDIENTS

Hazardous Components	Nominal Concentration (%)	Exposure Limits and Toxicity Data
Nitric Acid	5	ACGIH TLV-TWA: 2 mg/kg or 5 mg/m ³
		OSHA TLV-TWA: 2 mg/kg or 5 mg/m ³
		Human, Oral: LD ₅₀ : 430 mg/kg
Hydrofluoric Acid	2	ACGIH Ceiling: 3 mg/kg or 2.5 mg/m ³
		OSHA TLV-TWA: 3 mg/kg or 2.55 mg/m ³
		Man, Oral: TD ₅₀ : 143 mg/kg
		Human, Inhalation: LC ₅₀ : 50 mg/kg/30 min
		Man, Inhalation: TC ₅₀ : 100 mg/m ³ /5 min
Hafnium	1	ACGIH TLV-TWA: 0.5 mg/m ³
		OSHA TLV-TWA: 0.5 mg/m ³

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Nitric Acid	Hydrofluoric Acid	Hafnium
Appearance and Odor: a colorless to slightly yellow liquid that darkens to a brownish color upon aging and exposure to light; irritating, pungent odor	Appearance and Odor: a colorless, fuming liquid; strong, irritating, pungent odor	Appearance and Odor: gray, lustrous metal or powder
Relative Molecular Mass: 63.02	Relative Molecular Mass: 20.01	Relative Atomic Mass: 178.49
Density: 1.054 (10 % nitric acid)	Density: 0.987 to 0.991	Density: 13.3
Solubility in Water: soluble	Solubility in Water: soluble	Solubility in Water: insoluble
Solvent Solubility: decomposes in alcohol	Solvent Solubility: soluble in alcohol, benzene, toluene, <i>m</i> -xylene, and tetralin	Solvent Solubility: hydrofluoric acid

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this hafnium/hydrofluoric acid/nitric acid solution do not exist. The actual behavior of the solution may differ from the individual components.

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not applicable

Method Used: Not applicable

Autoignition Temperature: Not applicable

Flammability Limits in Air (Volume %): **UPPER:** Not applicable

LOWER: Not applicable

Unusual Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Hydrofluoric acid is a negligible fire hazard when exposed to heat and/or flames. Hydrofluoric acid may ignite or explode on contact with combustible materials. Hafnium is a severe fire hazard.

Extinguishing Media: Use extinguishing media that is appropriate to the surrounding fire. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen.

Special Fire Procedures: Fire fighters should wear a self-contained breathing apparatus (SCBA) with a full face piece in the pressure demand or positive mode and other protective clothing.

SECTION V. REACTIVITY DATA

Stability: X Stable Unstable

Conditions to Avoid: Avoid heat and contact with combustible and other incompatible materials.

Incompatibility (Materials to Avoid): Keep nitric acid away from organic materials, plastics, rubber, and some forms of coatings. Nitric acid is incompatible with chlorine, metal ferrocyanide, and ferrocyanide. Avoid contact with acids, bases, amines, halogens, halo carbons, cyanides, metals, metal oxides, metal salts, metal carbides, peroxides, oxidizing materials, and reducing agents.

See Section IV: *Unusual Fire and Explosion Hazards*

Hazardous Decomposition or Byproducts: Hazardous decomposition of nitric acid can produce various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO₂), nitrous oxide (N₂O), as well as nitric acid mist or vapor. Thermal decomposition of hydrofluoric acid may release halogenated (fluorinated) compounds. Thermal decomposition of hafnium may release oxides of hafnium and other miscellaneous products.

SECTION VI. HEALTH HAZARD DATA

Route of Entry: X Inhalation X Skin X Ingestion

Health Hazards (Acute and Chronic): Nitric Acid: Nitric acid may be fatal if inhaled, swallowed, or absorbed through skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Hydrofluoric Acid: Hydrofluoric acid may be fatal if inhaled, swallowed, or absorbed through the skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Repeated exposure to low concentrations may cause nasal congestion, nosebleeds, sinus problems, and bronchitis.

Direct eye contact with hydrofluoric acid may range from mild irritation to corneal burns. If the solution is not promptly removed, permanent visual defects and blindness may result. Hydrofluoric acid burns are characterized by blanched appearance of the skin with excruciating pain. Both the liquid and the vapor can cause severe burns that may not be immediately painful or visible. Solutions less than 2 % may cause burns. The full extent of tissue damage may not exhibit itself for 12 hours to 14 hours after exposure. Hydrogen fluoride will penetrate the skin and attack the underlying tissues and bone. Profound hypocalcemia can sometimes occur with fatal results. Chronic effects can include changes in bones and joints in humans.

Hafnium and Hafnium Compounds: Hafnium may be harmful by inhalation, ingestion, or skin absorption. Exposure may cause irritation of the skin, eyes, and mucous membranes. Animal studies indicate prolonged ingestion may cause liver damage. Hafnium fluoride may react with moisture to form hydrofluoric acid. See Health Hazards for Hydrofluoric Acid above.

Medical Conditions Generally Aggravated by Exposure: Nitric Acid: eye disorders, respiratory disorders, skin disorders, and allergies

Hydrofluoric Acid: bone, joint, or tooth disorders, kidney disorders, and respiratory disorders

Listed as a Carcinogen/Potential Carcinogen:

In the National Toxicology Program (NTP) Report on Carcinogens
In the International Agency for Research on Cancer (IARC) Monographs
By the Occupational Safety and Health Administration (OSHA)

Yes	No
_____	<u> X </u>
_____	<u> X </u>
_____	<u> X </u>

EMERGENCY AND FIRST AID PROCEDURES :

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Obtain medical assistance.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Obtain medical assistance.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Obtain medical assistance.

Ingestion: If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Obtain medical assistance immediately.

TARGET ORGAN(S) OF ATTACK:

Nitric Acid: skin, teeth, eyes, and upper respiratory tract

Hydrofluoric Acid: skin and skeletal system

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material Is Released or Spilled: Notify safety personnel of spills. Surfaces contaminated with spills should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Waste Disposal: Follow all federal, state, and local laws governing disposal.

Handling and Storage: Provide general and local explosion proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. Wear gloves and chemical safety glasses where contact with the liquid or high vapor concentrations may occur. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas thoroughly after handling.

NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

Store this material at room temperature.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources: MDL Information Systems, Inc., MSDS *Nitric Acid*, 01 June 2000.
MDL Information Systems, Inc., MSDS *Hydrogen Fluoride*, 21 March 2000.
MDL Information Systems, Inc., MSDS *Hafnium*, 21 March 2000.
The Merck Index, 11th Ed., 1989.
The Sigma Aldrich Library of Chemical Safety Data, Ed. II. 1988.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use in assessing the hazardous nature of the material. The MSDS was prepared carefully using current references; however, NIST does not certify the data on the MSDS. The certified value for this material is given in the NIST Certificate of Analysis.